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ARTHROSCOPIC FORAMINAL SURGICAL PROCEDURE

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(57) Claim

1. A method for percutaneously performing a foraminotomy or other surgical procedures in the spine of a human patient, comprising the steps of:

(a) posteriolaterally entering a patient's back through a puncture wound adjacent to the spine and spaced laterally therefrom, to contact a predetermined position on the spine, said wound extending between the transverse processes of adjacent vertebrae; and

(b) conducting a foraminotomy or other surgical procedure on the spine by manipulating instruments through the puncture wound;

(c) wherein in steps (a) and (b) substantially no removal of healthy tissue is required to allow visualization of and access to the foramen of the patient.

14. A method for percutaneously performing a foraminotomy or other surgical procedures in the spine of a human patient, comprising the steps of:

(a) posteriolaterally inserting a cannula through a patient's back adjacent to the spine and spaced laterally therefrom, to contact a predetermined position on the spine, said cannula inserted between the transverse processes of adjacent vertebrae; and

(b) conducting a foraminotomy or other

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surgical procedure on the spine by manipulating instruments through the cannula;

(c) wherein in steps (a) and (b) substantially no removal of healthy tissue is required to allow visualization of and access to the foramen of the patient.

27. A method for percutaneously performing a foraminotomy or other surgical procedures in the spine of a human patient, comprising the steps of:

(a) puncturing the patient's back at a location approximately 1 to 8 centimeters from the midline of the back and spaced laterally therefrom, said puncture extending between the transverse processes of adjacent vertebrae, and creating an opening to the transverse process of a vertebrae;

(b) inserting a cannula into the opening and advancing the cannula to the transverse process and lateral face of the facet joint of the vertebrae;

(c) introducing viewing means into the cannula;

(d) exposing the spinal cord nerve root located in the foramen of the vertebrae;

(e) adjusting the angle of the cannula so as to allow visualization of the vertebral canal through the intervertebral foramen of the vertebrae; and

(f) performing a foraminotomy or other surgical procedure through the cannula;

(g) wherein in steps (a) through (f) substantially no removal of healthy tissue is required to allow visualization of and access to the foramen of the patient.

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PATENTS ACT 1990

COMPLETE SPECIFICATION

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INVENTION TITLE:

Arthroscopic foraminal surgical procedures

The following statement is a full description of this invention, including the best method of performing it known to me/us:-

SPECIFICATION

Field of the Invention

The present invention relates to spine surgery, and more particularly to an arthroscopic method for performing foraminal surgical procedures in a spine of a human patient.

Background of the Invention

Certain pathological conditions of the spine create problems for surgeons because of their location within the spinal structures. One of the most difficult areas of the spine to operate on is the area surrounding the vertebral canal which is formed by the vertebral foramen, a bony opening in each vertebrae of the spine. The spinal cord passes through the vertebral canal and individual nerve roots pass through the intervertebral foramen between each vertebrae. On the posterior side of the vertebral foramen is the ligamentum flavum and on the anterior side is the posterior longitudinal ligament. The upper and lower boundaries of the intervertebral foramen are pedicles of the adjacent vertebrae

Even with the advances in arthroscopic spine surgery today, pathology found in the foraminal area is still only accessible by open back surgery in which it is necessary to make a large incision, resect a large amount of tissue not directly responsible for the patient's condition, and remove a portion of the

inferior articular process or an adjacent portion of the vertebrae in order to reach the foramen. Removing these vertebral structures causes spinal instability. When a portion of the bony structure of the vertebrae is not removed, inadequate decompression of the foramen occurs which does not alleviate a patient's pain. Further, the presently used open back surgical procedure subjects the patient to risk of infection, scarring, damage to unaffected structures, hospital stays of several days or more and extensive rehabilitation.

It would be advantageous to have an arthroscopic surgical procedure for treating areas of pathology found in the foramen which can be approach through incisions of less than 3 centimeters while resecting a minimum of soft tissue, and only that bony tissue which is directly responsible for the patient's symptoms.

It would also be advantageous to have a procedure that can be carried out under local anesthetic in which the patient can leave the hospital on the day of the surgery without incurring an overnight stay and avoid extensive rehabilitation.

Summary of the Invention

The invention is directed to a novel method for performing arthroscopic surgical procedures in the foramen of a spine of a human patient without removing any or a substantial amont of healthy tissue. In the method of the present invention, a surgeon posteriolaterally enters a patient's back through a puncture wound, adjacent to and spaced laterally from the spine, to contact a predetermined position on the spine. The wound is generally less than three centimeters in length, perferably between about 0.50 to 2.50 centimeters, and extends between the transverse

processes of adjacent vertebrae. The surgeon then conducts a foraminotomy or other surgical procedure in the area of the foramen by manipulating instruments through the puncture wound.

In an alternate embodiment, a cannula can be inserted through the puncture wound and advanced to the transverse process and lateral face of the facet joint of a vertebrae with the procedures being performed by manipulating the instruments through the cannula. Viewing means can be introduced through the cannula so as to allow visualization of the vertebral canal with the location of the cannula allowing for adjustability in angulation to accommodate a cephalad to caudad and horizontal to vertical line of vision. In a preferred embodiment, the cannula has an outer diameter of between about 0.50 to 3.00 centimeters, an inner diameter of between about 0.40 to 2.90 centimeters, and is of lengths sufficient to accommodate the tissue thickness of various patients, generally between about 2 to 10 centimeters. The foraminal surgical procedures that may be performed with the method of the present invention include foraminal decompressions, discectomies, fusions and the delivery of pharmaceuticals and bio-active devices.

Brief Description of the Drawings

A better understanding of the invention can be obtained from the detailed description of exemplary embodiments set forth below is viewed in conjunction with the accompanying drawings, in which:

FIGURE 1 is a posterior plan view of a portion of a spinal column;

FIGURE 2 is a side plan view of two adjacent vertebrae of the spinal column of FIG. 1;

FIGURE 3 is a pictorial view of a patient in a position for spinal surgery;

FIGURE 4 is a partially exposed schematic view of the placement of an incision in a patient's back;

FIGURE 5 is a cross-sectional view of the site line 3-3 of FIG. 4 showing a cannula inserted in the incision illustrated in FIG. 4;

FIGURE 6 is a posterior plan view of two adjacent vertebrae of a human spine illustrating the preferred location of a cannula used in the present invention;

FIGURE 7 is a fragmentary sectional view of a cannula used in the present invention;

FIGURE 8 is a side plan view of cannulas used in the present invention.

Detailed Description of Preferred Embodiment

Before describing the invention in detail, reference should be made to FIGs. 1 and 2 which illustrate the anatomy of a portion of a human spine generally designated by reference numeral 10. A human spine 10 is made up of individual vertebrae 12 and each vertebrae 12 includes a centrally located, outwardly projecting spinal process 14. Located at the superior end of each vertebrae 12, and extending laterally from each side, is a transverse process 16. Also at the superior end of the vertebrae 12 are two of upwardly projecting processes called the superior articular facets 18. The superior articular facets 18 interlock with two inferior articular processes 20, which are found on the inferior end of each vertebrae 12, forming the facet joint 19.

The space between the superior facet 18 and the inferior process 20 of each vertebrae 12 is called the lamina 22. A pedicle 24 attaches the above described vertebral structures to a vertebral body 26 illustrated

in FIG. 2. When individual vertebrae 12 are joined together as they are in a human spine 10, an opening is created between the pedicles 24 of adjacent vertebrae 12. This opening is called the intervertebral foramen 28 as shown in FIG. 2. The vetebral foramen of the vertebrae 12 form the vertebral canal 15 of the spine 10 through which the spinal cord passes. Individual nerve roots pass through each intervertebral foramen 28 between the vertebrae 12.

As can be appreciated from the illustrations of the spine 10 in FIGS. 1 and 2, pathological conditions in the area of the foramen 28 are difficult areas to reach and operate on because of their location and placement in relation to the spinal cord and nerve roots.

The present invention is directed to a method for performing arthroscopic spinal procedures in the foramen 28 of a spine 10 of a human patient without removing substantial amounts of healthy tissue such as the inferior articular process 20, portions of the lamina 22, or ligaments.

In the procedure in accordance with the invention, a patient P is positioned prone on an operating table O and a fluoroscope F is moved into position as illustrated in FIG. 3. With the use of the fluoroscope F, the midlines of the transverse processes 16 of adjacent vertebrae 12 at the level of interest is located and the skin of the patient's back B is marked along the centerline of the vertebrae 12. A puncture wound or incision 30, generally less than 3 centimeters in length and perferably between about 0.50 to 2.50 centimeters, is made in the posterolateral portion of the patient's back B, adjacent to the spine and spaced laterally therefrom as shown in FIG.4. The incision 30 is placed generally about from 1 to 8 centimeters from

the midline M of the patient's back B depending on the bone structure of the patient P.

The incision 30 is carried through the skin, the subcutaneous tissue, and the fascial envelope of the dorsal musculature of the patient's back B. A surgeon's finger or other blunt instrument is introduced into the incision 30 and the muscle fibers are bluntly dissected longitudinally to allow the transverse process 22 to be palpitated with the finger or blunt instrument. The lateral face of the facet joint 19 is also palpated with the finger.

The incision 30 can be kept open with retractors (not shown) or, in a preferred embodiment, a cannula 32 is used. If the cannula 32 is used, a blunt bullet-nosed trocar 33, of a kind routinely used in surgical procedures and commercially available and slightly smaller than the diameter of the cannula 32, is passed into the incision 30 and directed at an angle of approximately 30° - 45° from the vertical axis of the midline M of the patient's back B. The trocar 33 is not passed deeper than the level of the intertransverse membrane.

The cannula 32, of the desired diameter and appropriate length for the thickness of the patient's tissue, is then passed over the trocar 33 (FIG. 5). The cannula 32 is positioned between the transverse processes 16 of adjacent vertebrae 12 and is advanced to rest upon the lateral face of the facet joint 19 as illustrated in FIGS. 5 and 6. The trocar 33 is removed from the incision 30.

A device which allows for directly viewing the area to be operated on is inserted into the cannula. The viewing device can be a microscope, magnifying loops in near-coaxial illumination, fiberoptics or any other viewing system.

Bipolar electrocautery is used to cauterize the muscle attachments of the intertransverse membrane along the adjacent margins of the transverse processes 16 as well as the lateral face of the facet joint 19. A long slender curette (not shown) is then used to detach the muscle from the transverse processes 16 and the facet joint 19. The curette then enters the area of the foramen 28. A nerve hook and pituitary rongeur (not shown) are used to dissect away the intertransverse membrane tissue, exposing the underlying nerve root. Exploration and observation will reveal the nerve root itself, the intervertebral disc, a portion of the vertebral canal, the pedicles 24 above and below the nerve root and any pathology that lies in the foraminal area.

Once the area surrounding the foramen 28 has been decompressed, it is possible to visualize directly into the central neural sac. With curved instruments, it is possible to palpitate the subarticular zone above and below the entry to the vertebral canal 15. However, in order to visualize this area for direct inspection, it is necessary to employ a video device or other optical system which can turn corners.

Extraforaminal disc herniations, extraforaminal marginal osteophytes, hypertrophied and/or cephalad subluxed superior facet process, and marginal osteophytes of the facet joint can all be resected through the incision 30 or cannula 32 using small angled and curved Kerrison rongeurs, as well as small chisels and graspers. Also, discectomies, intertransverse fusion and percutaneous pedicle screw fixation in this area may be performed with the appropriate instruments inserted through the incision 30 or cannula 32 on either side of the midline M. It is also possible to use more than one cannula 32 in a

unilateral approach if the pathological condition in the area indicates that the procedure needs to be carried out using two smaller cannula with this approach. Additionally, the delivery of pharmaceuticals and bio-active devices, such as genetically engineered drugs, can be introduced into this area through the cannula 32.

When the surgical procedure is completed, the cannula 32 is removed and the incision 30 can be closed with one or two interrupted subcutaneous sutures and an adhesive strip.

The location of the cannula 32 in relation to the vertebral structures allows the cannula 32 to be angled within an extensive range so that the line of vision may be varied cephalad to caudad and horizontal to vertical. There are no structural restraints to hamper this extensive range of angulation. The placement of the cannula 32 also allows the surgeon to look virtually straight down or at approximately a 60° angle from a vertical axis perpendicular to the midline M of the patient's back in order to look into the foramen 28 and across tc the central dural sac and the central disc area. The cannula's 32 location between the transverse processes 16 and the lateral face of the facet joint 19 prevents the cannula 32 from penetrating below the level of the intertransverse plane.

In a preferred embodiment, the cannula 32 is formed from a biocompatible material, such as stainless steel, in the shape of a cylindrical tube with a body portion 34 and a collar 36, as illustrated in FIGS. 7 and 8. The exterior surface of the collar 36 has a knurled roughened surface which allows a surgeon to better grip the collar 36 of the cannula 32 as it is being inserted and manipulated in a patient P during the procedure.

The cannula body 34 has an internal bore or surface 38 and an external surface 40 with the end of the cannula body 34, opposite the collar 36, having a slight taper as shown in FIGS. 7 and 8. The outer diameter of the cannula body 34 is perferably between about 0.50 to 3.00 centimeters and the internal bore diameter is perferably between about 0.40 to 2.90 centimeters. The cannula 32 can be of lengths sufficient to accommodate the thickness of a variety of patient's tissue when fully inserted, perferably between about 2 to 10 centimeters long.

The method of the present invention provides a way to treat areas of pathology found in the foramen which can be approached through incisions of less than 3 centimeters while resecting a minimum of soft tissue, and only that bony tissue which is directly responsible for the patient's symptoms. The method of the present invention also allows the procedure to be carried out under local anesthetic which enables the surgeon to stimulate the nerve root and receive information from the patient as to the distribution of sensations. The use of local anesthetic also allows the patient to leave the hospital on the day of surgery without incurring an overnight stay.

It should be understood that there can be improvements and modifications made to the embodiments of the invention described in detail without departing from the spirit or scope of the invention as set forth in the accompanying claims.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A method for percutaneously performing a foraminotomy or other surgical procedures in the spine of a human patient, comprising the steps of:

(a) posteriolaterally entering a patient's back through a puncture wound adjacent to the spine and spaced laterally therefrom, to contact a predetermined position on the spine, said wound extending between the transverse processes of adjacent vertebrae; and

(b) conducting a foraminotomy or other surgical procedure on the spine by manipulating instruments through the puncture wound;

(c) wherein in steps (a) and (b) substantially no removal of healthy tissue is required to allow visualization of and access to the foramen of the patient.

2. The method of claim 1, further comprising the step of viewing the foraminotomy or other surgical procedure under fluoroscopic X-ray.

3. The method of claim 1, wherein the puncture wound is an incision generally less than 3 centimeters in length.

4. The method of claim 3, wherein the puncture wound is between about 0.50 to 2.50 centimeters.

5. The method of claim 1, further comprising the steps of:

(d) passing a trocar into the puncture wound and directing the trocar at an angle of approximately 30 to 45° off the vertical axis of a midline of a patient's back;

(e) passing a cannula over the trocar and advancing it to the lateral face of the facet joint of the vertebrae; and

(f) removing the trocar from the wound.

6. The method of claim 5, wherein the cannula has an outer diameter between about 0.50 to 3.00 centimeters and is of a length between about 2.0 to 10.00 centimeters.

7. The method of claim 6, wherein the cannula has an internal bore of between about 0.40 to 2.90 centimeters.

8. The method of claim 5, wherein the cannula is adjustable in its angulation to accommodate a cephalad to caudad and horizontal to vertical line of vision.

9. The method of claim 1, further comprising the step of visualizing certain areas for direct inspection with viewing means having the capability of turning corners.

10. The method of claim 1, wherein the foraminotomy includes decompressions.

11. The method of claim 1, wherein the foraminotomy includes discectomies.

12. The method of claim 1, wherein the other surgical procedures include fusions.

13. The method of claim 1, wherein the other surgical procedures include the delivery of pharmaceuticals and bio-active devices.

14. A method for percutaneously performing a foraminotomy or other surgical procedures in the spine of a human patient, comprising the steps of:

(a) posteriolaterally inserting a cannula through a patient's back adjacent to the spine and spaced laterally therefrom, to contact a predetermined position on the spine, said cannula inserted between the transverse processes of adjacent vertebrae; and

(b) conducting a foraminotomy or other surgical procedure on the spine by manipulating instruments through the cannula;

(c) wherein in steps (a) and (b) substantially no removal of healthy tissue is required to allow visualization of and access to the foramen of the patient.

15. The method of claim 14, further comprising the step of viewing the foraminotomy or other surgical procedure under fluoroscopic X-ray.

16. The method of claim 14, wherein the puncture wound is an incision generally less than 3 centimeters in length.

17. The method of claim 16, wherein the puncture wound is between about 0.50 to 2.50 centimeters.

18. The method of claim 14, further comprising the steps of:

(d) passing a trocar into the puncture wound and directing the trocar at an angle of approximately 30 to 45° off the vertical axis of a midline of a patien's back;

(e) passing the cannula over the trocar and advancing it to the lateral face of the facet joint of the vertebrae; and

(f) removing the trocar from the wound.

19. The method of claim 14, wherein the cannula has an outer diameter between about 0.50 to 3.00 centimeters and is of a length between about 2.0 to 10.0 centimeters.

20. The method of claim 19, wherein the cannula has an internal bore of between about 0.40 to 2.90 centimeters.

21. The method of claim 14, wherein the cannula is adjustable in its angulation to accommodate a cephalad to caudad and horizontal to vertical line of vision.

22. The method of claim 14, further comprising the step of visualizing certain areas for direct inspection with viewing means having the capability of turning corners.

23. The method of claim 14, wherein the foraminotomy includes decompressions.

24. The method of claim 14, wherein the foraminotomy includes discectomies.

25. The method of claim 14, wherein the other surgical procedures include fusions.

26. The method of claim 14, wherein the other surgical procedures include the delivery of pharmaceuticals and bio-active devices.

27. A method for percutaneously performing a foraminotomy or other surgical procedures in the spine of a human patient, comprising the steps of:

(a) puncturing the patient's back at a location approximately 1 to 8 centimeters from the midline of the back and spaced laterally therefrom, said puncture extending between the transverse processes of adjacent vertebrae, and creating an opening to the transverse process of a vertebrae;

(b) inserting a cannula into the opening and advancing the cannula to the transverse process and lateral face of the facet joint of the vertebrae;

(c) introducing viewing means into the cannula;

(d) exposing the spinal cord nerve root located in the foramen of the vertebrae;

(e) adjusting the angle of the cannula so as to allow visualization of the vertebral canal through the intervertebral foramen of the vertebrae; and

(f) performing a foraminotomy or other surgical procedure through the cannula;

(g) wherein in steps (a) through (f) substantially no removal of healthy tissue is required to allow visualization of and access to the foramen of the patient.

28. The method of claim 27, further comprising the step of viewing the foraminotomy or other surgical procedure under fluoroscopic X-ray.

29. The method of claim 27, wherein the puncture wound is an incision generally less than 3 centimeters in length.

30. The method of claim 29, wherein the puncture wound is between about 0.50 to 2.50 centimeters.

31. The method of claim 27, further comprising the steps of:

(h) passing a trocar into the puncture wound and directing the trocar at an angle of approximately 30 to 45° off the vertical axis of a midline of a patient's back;

(i) passing the cannula over the trocar and advancing it to the lateral face of the facet joint of the vertebrae; and

(j) removing the trocar from the wound.

32. The method of claim 27, wherein the cannula has an outer diameter between about 0.50 to 3.00 centimeters and is of a length between about 2.0 to 10.00 centimeters.

33. The method of claim 32, wherein the cannula has an internal bore of between about 0.40 to 2.90 centimeters.

34. The method of claim 27, wherein the cannula is adjustable in its angulation to accommodate a cephalad to caudad and horizontal to vertical line of vision.

35. The method of claim 27, further comprising the step of visualizing certain areas for direct

inspection with viewing means having the capability of turning corners.

36. The method of claim 27, wherein the foraminotomy includes decompressions.

37. The method of claim 27, wherein the foraminotomy includes discectomies.

38. The method of claim 27, wherein the other surgical procedures include fusions.

39. The method of claim 27, wherein the other surgical procedures include the delivery of pharmaceuticals and bio-active devices.

40. A method for percutaneously performing a foraminotomy or other surgical procedures in the spine of a human patient substantially as hereinbefore described with reference to the drawings.

41. The steps, features, compositions and compounds disclosed herein or referred to or indicated in the specification and/or claims of this application, individually or collectively, and any and all combinations of any two or more of said steps or features.

DATED this FOURTH day of APRIL 1995

Spinecare Medical Group

by DAVIES COLLISON CAVE
Patent Attorneys for the applicant(s)

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FIG.1.

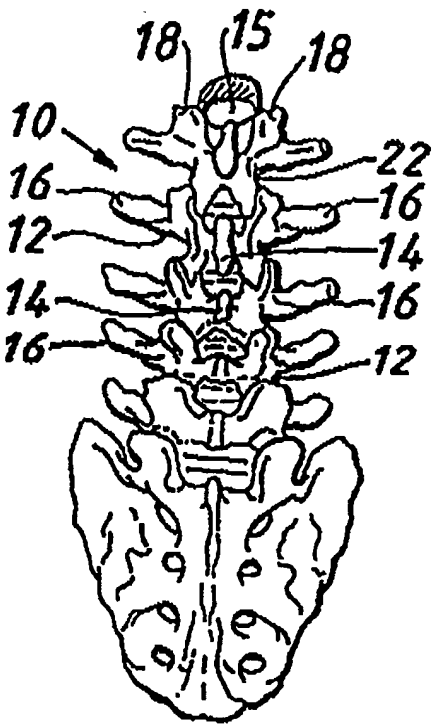

FIG.3.

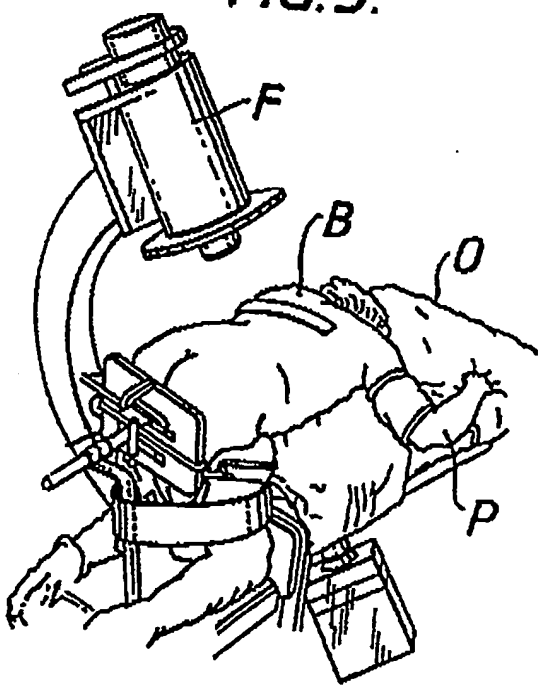

FIG.2.

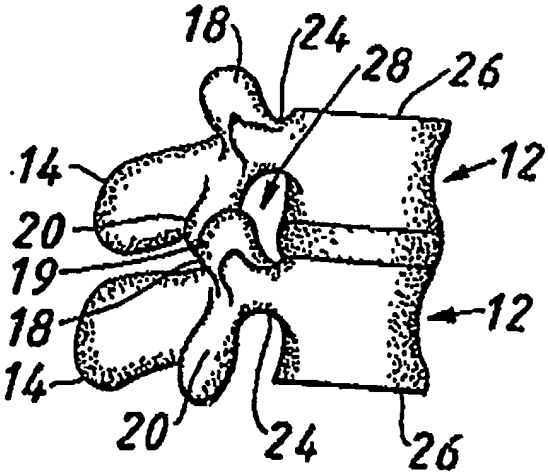

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FIG. 4.

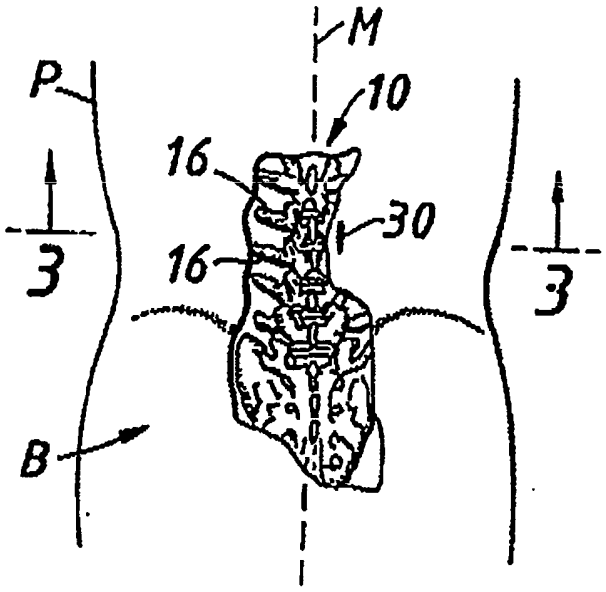


FIG. 5.

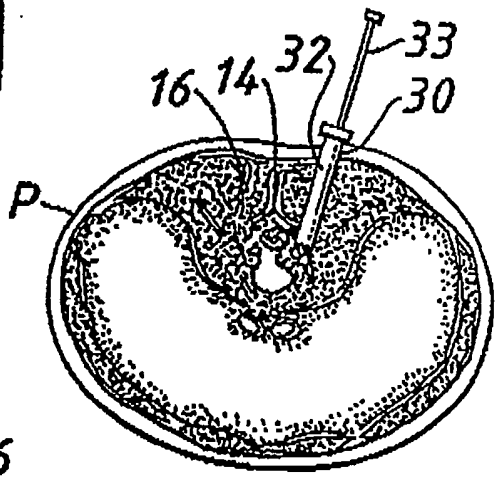


FIG. 6.

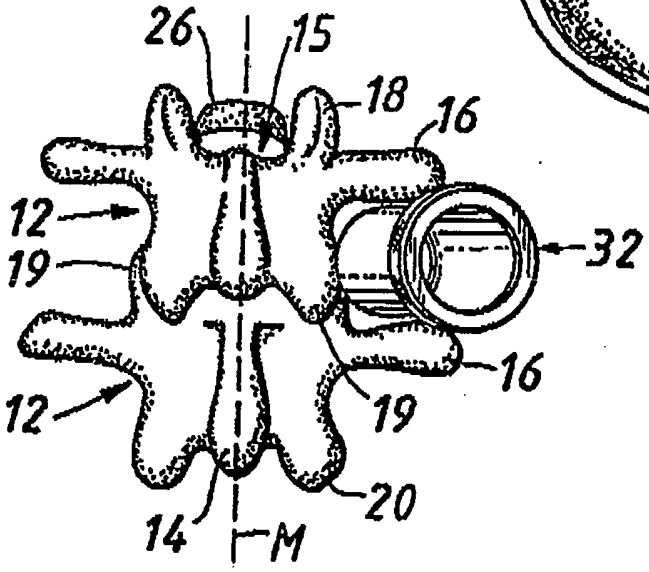
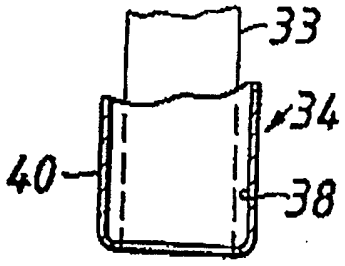


FIG. 7.



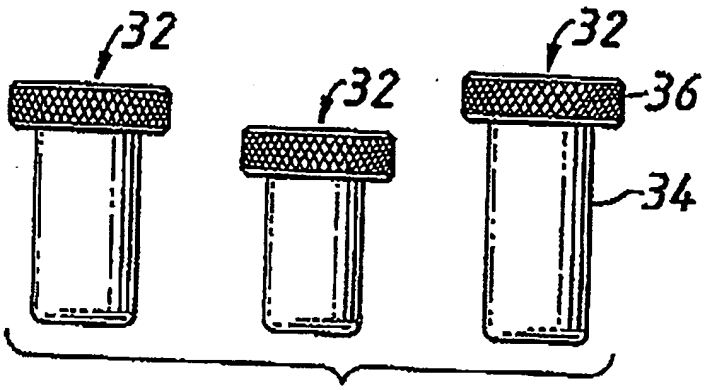


FIG. 8.